WHAT IS CLAIMED IS:

1. A single crystal ceramic material for optical and optoelectronic applications, comprising a single crystal spinel having a general formula $aAD \cdot bE_2D_3$, wherein A is selected from the group consisting of Mg, Ca, Zn, Mn, Ba, Sr, Cd, Fe, and combinations thereof, E is selected from the group consisting Al, In, Cr, Sc, Lu, Fe, and combinations thereof, and D is selected from the group consisting O, S, Se, and combinations thereof, wherein a ratio $b:a > 1:1$ such that the spinel is rich in E_2D_3, and the single crystal spinel is formed by a melt process.

2. The material of claim 1, wherein A is Mg, D is O, and E is Al, such that the single crystal spinel has the formula $aMgO \bullet bAl_2O_3$.

3. The material of claim 1, wherein the single crystal spinel is grown from a melt provided in a crucible.

4. The material of claim 1, wherein the material has a lower mechanical stress and strain compared to stoichiometric spinel.

5. The material of claim 1, wherein the material consists essentially of a single phase of said spinel, with substantially no secondary crystalline phases.

6. The material of claim 1, wherein b:a is not less than about 1.2:1.

7. The material of claim 1, wherein b:a is not less than about 1.5:1.

8. The material of claim 1, wherein b:a is not less than about 2.0:1.

9. The material of claim 1, further comprising Co, wherein the ceramic material forms a saturable absorber Q-switch.

10. The material of claim 9, wherein the saturable absorber Q-switch has a formula $Mg_{1-x}Co_xAl_yO_z$ where x is greater than 0 and less than about 1, y is greater than 2 and less than about 8, and z is between about 4 and about 13, said single crystal having tetrahedral and octahedral positions, and wherein most of the magnesium and cobalt occupy tetrahedral positions.

11 A method of forming a monocrystalline spinel material, comprising:
forming a melt; and
growing a spinel single crystal from the melt, the single crystal spinel having a general formula $aAD \cdot bE_2D_3$, wherein A is selected from the group consisting of Mg, Ca, Zn, Mn, Ba, Sr, Cd, Fe, and combinations thereof, E is selected from the group consisting Al, In, Cr, Sc, Lu, Fe, and combinations thereof, and D is selected from the group consisting O, S, Se, and combinations thereof, wherein a ratio $b:a > 1:1$ such that the spinel single crystal is rich in E_2D_3.

12. The material of claim 11, wherein A is Mg, D is O, and E is Al, such that the single crystal spinel has the formula $aMgO \bullet bAl_2O_3$.

13. The material of claim 11, wherein b:a is not less than about 1.5:1.

14. The method of claim 11, wherein the melt is provided in a crucible.

15. The method of claim 11, wherein the single crystal is grown by contacting a seed crystal with the melt.

16. The method of claim 15, wherein the seed crystal and the melt are rotated with respect to each other during growing.

17. The method of claim 16, wherein rotation is carried out at a rate within a range of about 2 to about 12 rpms.

18. The method of claim 15, wherein the seed crystal is withdrawn from the melt within a range of about 0.04 inches/hour to about 0.1 inches/hour.

19. The method of claim 11, wherein A is Mg, D is O, and E is Al, the spinel single crystal further includes Co, and the spinel single crystal forms a saturable absorber Q-switch.

20. The method of claim 19, wherein a molar ratio of Mg:Co:Al of the spinel is (1-x):x:y, where x is greater than 0 and less than about 1, and y is greater than 2 and less than about 8.

21. The method of claim 11, wherein the melt is heated to a temperature greater than about 2150 °C.